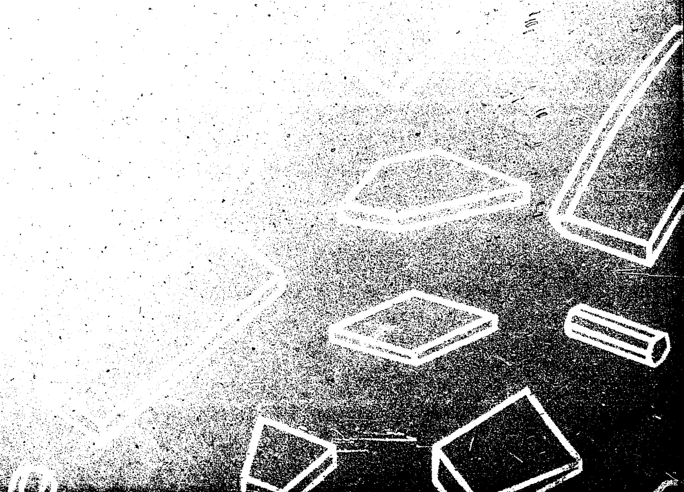
HARD ALLOYS

FOR THE MINING INDUSTRY



STANKOIMPORT

VSESOJUZNOJE EXPORTNO-IMPORTNOJE OBJEDINENIJE

STANKOIMPORT

HARD ALLOYS

FOR THE MINING INDUSTRY

CATALOGUE
AND
INSTRUCTIONS

№ 11

U S S R

MOSCOW

Attention of Carbide Consumers

The application of hard alloys for metal drawing is described in our catalogue No. 10

A new catalogue (No. 12) is being prepared for print

"Sintered Carbides for metal cutting"

(Supersedes catalogue No. 08)

This catalogue is published on the basis of new State Standards GOST 3882-53 and GOST 880-53

Supersedes catalogue No. 09

CONTENTS

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I

GENERAL INFORMATION AND TIP STANDARDS

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HIGHLY EFFICIENT AND ECONOMICAL MINING PRODUCTION IS IMPOSSIBLE WITHOUT THE USE OF HARD ALLOYS

MORE THAN 90 PER CENT OF ALL THE DRILLING PERFORMED IS CARRIED OUT BY HARD-ALLOY TIPPED BORING TOOLS

In the Soviet Union the drilling by hard-alloy tipped tools has been introduced into the oil industry since 1926 and into the mining industry since 1931.

Since then the hard alloys came more and more to the fore among other tool-making materials and at the present time more than 90% of all the drilling performed in the Soviet Union is carried out by hard-alloy tipped boring tools.

EFFICIENCY EXCEEDS 300 PER CENT

The extremely valuable properties of the hard alloys i. e. their great hardness, high wear-resistance and sufficient toughness and durability allow to perform the rock drilling with very high cutting speeds and to increase the efficiency of drilling not less than three times as compared with ordinary tools.

The application of hard alloys is particularly efficient when drilling in hard and highly hard formations, the efficiency increasing directly with the hardness of the formation.

The application of hard alloys in the oil field and in the mining industry has contributed to the creation of the most perfect designs of drilling tools, drilling outfits and has allowed to introduce the multicycle method of work into the stopes as well as widely use the multistope drilling.

Hard alloys allowed to introduce high efficient electric drilling, coal combines and coal cutters.

Due to the hard alloys drilling deep explosive pit-holes of large diameters is now widely used in the mining industry, thus allowing to increase the efficiency of ore picking up to 2—3 times.

REDUCED TRANSPORT COSTS

The life of the hard alloy tipped percussive drills is 50—100 times longer than that of carbon steel drills. This remarkable wear-resistance of hard alloys completely eliminates the necessity of delivering large quantities of steel drill rods to the stope and consequently considerably reduces transport costs and saves labour. The operator can do with one set of detachable hard-alloy tipped core bits or drill bits during one to three shifts without any help of auxiliary personnel.

PRODUCTION COSTS REDUCED FOUR TIMES

The numerous advantages gained by the use of hard-alloy tipped rock drills (such as faster rate of drilling, increased outputs and many other indirect, but very important factors) considerably reduce production costs.

In some cases, depending on local conditions, the cost per one meter drilled when using hard-alloy tipped drills is 10 times lower than when using steel drills.

It may be assumed that on the average with the use of hard-alloy tipped drills production costs are reduced four times.

A WIDE RANGE OF SHAPES AND GRADES OF HARD ALLOYS AVAILABLE FOR ANY DRILLING CONDITIONS

The extreme variety of conditions in mines, oil fields and prospecting shafts resulting from the nature andhardness of the formations, types of drilling tools used, rate of pressure, stress imposed on the tools, diameter and the deepness of the pit-holes and many other features, has called for the development of not only a whole line of standard shapes, sizes and grades of hard alloys but of different kinds of alloys as well.

To meet this necessity a great variety of shapes and grades of hard alloys is produced which can satisfy the whole range of requirements of all the branches of the mining industry.

SHAPES AND GRADES OF HARD ALLOYS FOR THE MINING INDUSTRY

1. SINTERED CARBIDES

This type of hard alloy which enjoys the most extensive application in the mining industry consists of the finest grains of carbides (carbon compositions) of rare refractory metals cemented by a binding metal-cobalt.

Owing to a special method of manufacture, which consists in pressing the powders and sintering them without bringing the entire compound to the melting point, these alloys maintain the extremely valuable properties of the initial carbides, the hardness of which is almost identical to that of the diamond, combined with toughness resulting from the presence of cobalt.

In the mining industry the tungsten-cobalt sintered carbide alloys are used i. e. such alloys in which the tungsten carbide is the basic component.

Tungsten-cobalt sintered carbides for the mining industry are produced in the following grades:

BK 15, BK 11, BK 8 and BK 6

These sintered carbide grades are remarkable for their high wear-resistance, toughness and durability in drilling rock formations of different degrees of hardness.

2. TUBE HARD-FACING ALLOYS

The tube hard-facing alloy bearing the common trade mark "RELIT T3" represents a tube into which different particles of cast tungsten carbide are fed.

This alloy possesses a high wear-resistance, withstands severe impacts and maintains its properties under high temperature which arise when "RELIT T3" is welded on the tool by an oxyacetylene flame.

The application of this kind of hard alloy has been called forth by the fact that, when drilling deep oil wells, the drilling tools are subjected to enormous impacts which often lead to the breakage of the sintered carbide.

3. POWDERED HARD-FACING ALLOYS

The powdered hard-facing alloys represent a powder-like mixture composed of the components of the given alloy. This mixture acquires the properties of the alloy after being deposited on surfaces subject to rapid wear by welding.

For the hard-facing of drilling tools a powdered hard alloy of the trademark "VOCAR" is applied which consists of grains of tungsten carbide cemented by treacle coke.

The depositing of "VOCAR" is carried out by means of an electric arc.

In the course of this operation "VOCAR" is fused with the parent metal at a depth of 2—3 mm.

The presence of a large amount of carbon in the composition of "VOCAR" allows to obtain a protective and carbonized atmosphere in the zone of the electric arc, which prevents tungsten from oxidizing and contributes to the formation of tungsten carbides.

PROPER SELECTION OF HARD ALLOY GRADES ESSENTIAL FOR THE EFFECTIVE APPLICATION OF TOOLS

The proper selection of the hard alloy grade for any particular purpose is a very important factor for the effective application of the hard alloy.

This should be always borne in mind as most of the failures occuring in the application of hard alloys are due to the selection of wrong grades, completely unsuitable for the given purpose.

The following are the main points to be considered when selecting the grades and shapes of hard alloys:

1) Physical and mechanical properties of rock formations (structure, strength, viscosity, abrasion).

2) Method of destroying the formations (cutting, cleaving, tumbling, crushing).

3) Type of equipment to be used.

4) Capacity of the equipment.

Sintered Carbide "BK 15" possesses maximum durability and very high wear-resistance owing to which it is extensively used for percussive rock drilling in medium and hard formations. The grade "BK 15" is mostly efficient when applied for drilling in hard formations by heavy duty percussive machines. This grade is recommended as highly efficient for use with core bits and four-edged drag bits when drilling in rock formations, the hardness of which exceeds 16 according to prof. Protodiakonov's scale, and with core bits and single-edged chisel drill bits for use in rock formations having a hardness up to 16 according to the same scale.

When drilling fissured rock formations, only four-edged drill bits should be applied.

Sintered Carbide "BK 11" possesses high toughness and has greater wear-resistance than the "BK 15" carbide. "BK 11" is mostly efficient when drilling high abrasive formations. The "BK 11" grade is recommended for percussive drilling in formations having a hardness of 16 according to prof. Protodiakonov's scale.

Sintered Carbide "BK 8" owing to its great wear-resistance is now extensively used in oil well drilling with rotary type chisel-edged drill bits and with various kinds of core heads, as well as for bits of electric drills, cutter picks and coal combines.

It is not recommended to use drill bits tipped with "BK 8" for drilling under great impact loads, this grade being more brittle than grades "BK 15" and "BK 11".

Sintered Carbide "BK 6" is the most wear-resistant of all grades of sintered carbides applied in the mining industry. It is intended for tipping electric drills used for drilling hard coals free of pyrite inclusions and homogeneous rock formations. It can be used for tipping cores of prospecting boring and for chisels of oil well drilling.

It is not allowed to subject this grade of alloy to heavy impacts.

Powdered hard-facing alloy "VOCAR" is intended for hard-facing of oil-well boring bits, both by itself and in combination with other grades of hard alloys.

The wear-resistance and, consequently, brittleness of "VOCAR" can be varied by varying the number of the deposited layers.

Tube hard-facing alloy "RELIT T 3" which forms a deposit of great hardness and wear-resistance combined with high toughness is extensively applied for the tipping of crushing and cutting type bits used in the oil industry.

This hard alloy grade also can be successfully used for other kinds of deep oil-well drilling performed by means of the percussion and rotary methods.

The table given below shows various kinds and grades of hard alloys and the recommended applications of same with particular tools and for particular rock formations.

In some cases, however, due to specific conditions of application, this table may prove insufficient. In these cases the Vsesojuznoje Exportno-Importnoje Objedinenije "Stankoimport" should be applied to for detailed information.

CHARACTERISTICS AND APPLICATIONS OF HARD ALLOYS

Carbide grade	Characteristics of carbides	Suggested to apply
a) SINTERED CARBIDES		
BK 15	The highest durability. Possesses high resistance against severe shocks.	For drilling in hard and extremely hard rock formations under high pressures of compressed air by heavy duty percussive machines. For tipping core heads of large diameters.
BK 11	High durability, more wear-resistant than grade BK 15	For drilling in medium and hard abrasive rock formations by percussive machines of all types. For cutting stones of high hardness.
BK 8	High wear-resistance and high durability.	For drilling soft rock formations (up to $f = 8$) by hand percussive electric drills. For drilling by electric and pneumatic drills in coal and antracite of high and extremely high hardness. For under-cutting of coal. For rotary drilling, for boring of prospective and explosive pit-holes. For rotary oil drilling by "PX" style bits and 3-edged bits. For stone-dressing tools used for cutting natural and artificial building materials.
BK 6	The strongest and most wear-resistant of all sintered carbide grades intended for rock drilling. Susceptible to impacts.	For drilling in hard coal and antracite formations free from pyrite inclusions by electric drills. For drilling in schist free of silicon, potassium and rock salts and other formations of homogeneous structure by electric drills. For sawing marble and lime formations up to medium hardness.
b) OTHER KINDS OF HARD ALLOYS		
Relit T3	Steel tubes containing grains of cast tungsten carbide. This hard alloy possesses great wear-resistance and toughness.	Hard-facing of oil boring bits (reed roller, fish-tail, etc.) with pure "Relit T3", or in combination with other grades of hard alloys.
Vocar	Powdered alloy. The hardness and toughness of the deposited hard-faced alloy can be varied by varying the number of layers.	Hard-facing of oil boring bits, with pure "Vocar" or in combination with other hard-facing alloys.

PHYSICAL AND MECHANICAL PROPERTIES OF SINTERED CARBIDES FOR MINING INDUSTRY

Grade	Specific gravity	Rockwell A Hardness, minimum	Ultimate bending strength in kg/mm^2, minimum
BK 15	13.9—14.1	86.0	160
BK 11	14.0—14.4	86.0	150
BK 8	14.4—14.8	87.5	130
BK 6	14.6—15.0	88.0	120

II

SHAPES AND SIZES OF STANDARD SINTERED CARBIDE TIPS FOR ROCK BORING TOOLS

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STANDARD TIPS OF SINTERED CARBIDES

As a result of an extensive and thorough investigation of the properties of hard alloys and the nature of their wear in the process of rock drilling, there were designed and standardized the most rational shapes and sizes of carbide tips for the tipping of boring tool bits.

In order to meet the requirements of the carbide consumers our standard tips have been provided with such angles and bevels, which considerably reduce time and save grinding materials used for sharpening the tools.

Standard tips are available from stock for prompt delivery.

When selecting carbide tips for percussive drilling, the following main points should be taken into consideration:

Tips of Γ11 shape are used for tipping detachable drill bits and single-edged drill bits with sidelong washing, with diameters up to 49 mm. Some numbers of shapes Γ110, Γ111, Γ112, Γ113 can be used for tipping core heads of large diameter with central washing.

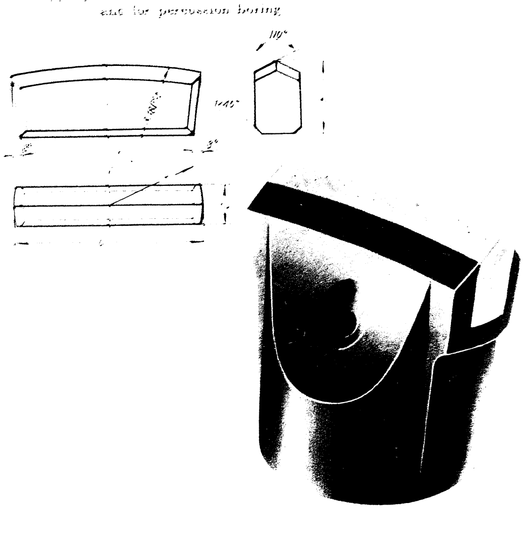
Tips of Γ12 and Γ13 shapes are recommended for tipping core heads and core bits of four-edged drag or core bits with central washing up to 65 mm diameter.

Tips of Γ118 und Γ119 shapes are recommended for tipping core bits intended for drilling in high abrasive formations where the wear of the core head bit across the diameter exceeds that across the bit height.

Tips of Γ11 and Γ12 shapes with thickness of 8 mm are recommended to use in drilling of low abrasive homogeneous formations of medium hardness.

SHAPE Г 11

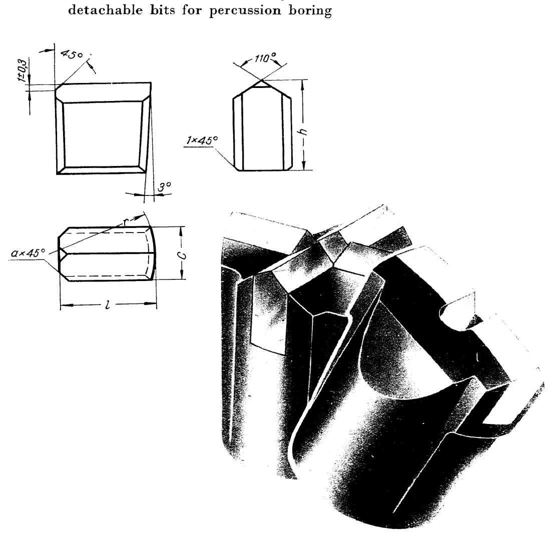
for tipping detachable single-edged chisel rock bits
and for percussion boring



Tip No.	Dimensions in mm				Average weight of carbide tip of grades (in g)	
	l	h	c	r	BK 11	BK 15
Г 110	32	18	8	16	50.8	50.0
Г 111	32	18	10	16	69.4	68.4
Г 112	35	18	8	17.5	61.6	60.7
Г 113	35	18	10	17.5	74.9	73.9
Г 114	40	18	8	20	70.0	68.0
Г 115	40	18	10	20	86.8	85.5
Г 116	43	18	8	21.5	75.4	74.3
Г 117	43	18	10	21.5	92.3	91.0
Г 118	46	18	10	23	98.5	97.0
Г 119	49	18	10	24.5	105.0	103.4

SHAPE Г 12

for tipping 4-edged and single-edged drilling
detachable bits for percussion boring



Tip No.	Dimensions in mm					Average weight of carbide tip of grades (in g)	
	l	h	c	r	a	BK 11	BK 15
Г 121	17	18	8	20	1	29.9	29.4
Г 122	18	18	10	21	1.5	38.5	38.0
Г 123	20	18	8	23	1	34.3	33.8
Г 124	20	18	10	23	2	42.7	42.1
Г 125	21.5	18	10	24.5	2	46.3	45.6
Г 126	24	18	10	27	2	52.4	51.6
Г 127	26	18	10	29	2	56.7	55.9
Г 128	28	18	10	31	2	62.1	61.2

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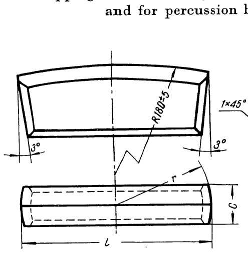
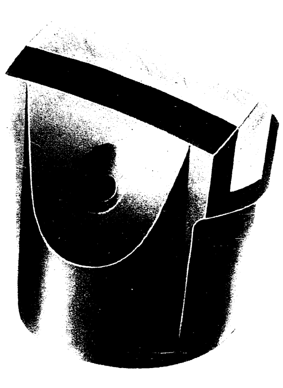
SHAPE Г 11

for tipping detachable single-edged chisel rock bits and for percussion boring

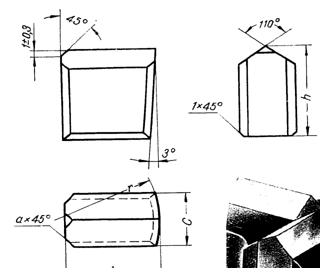


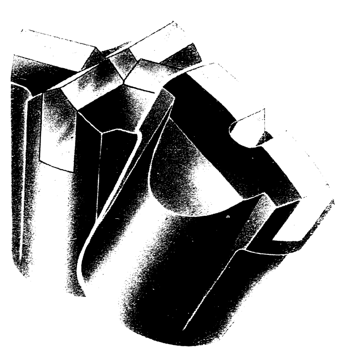


Tip No.	Dimensions in mm				Average weight of carbide tip of grades (in g)	
	l	h	c	r	BK 11	BK 15
Г 110	32	18	8	16	50.8	50.0
Г 111	32	18	10	16	69.4	68.4
Г 112	35	18	8	17.5	61.6	60.7
Г 113	35	18	10	17.5	74.9	73.9
Г 114	40	18	8	20	70.0	68.0
Г 115	40	18	10	20	86.8	85.5
Г 116	43	18	8	21.5	75.4	74.3
Г 117	43	18	10	21.5	92.3	91.0
Г 118	46	18	10	23	98.5	97.0
Г 119	49	18	10	24.5	105.0	103.4

SHAPE Г 12

for tipping 4-edged and single-edged drilling detachable bits for percussion boring



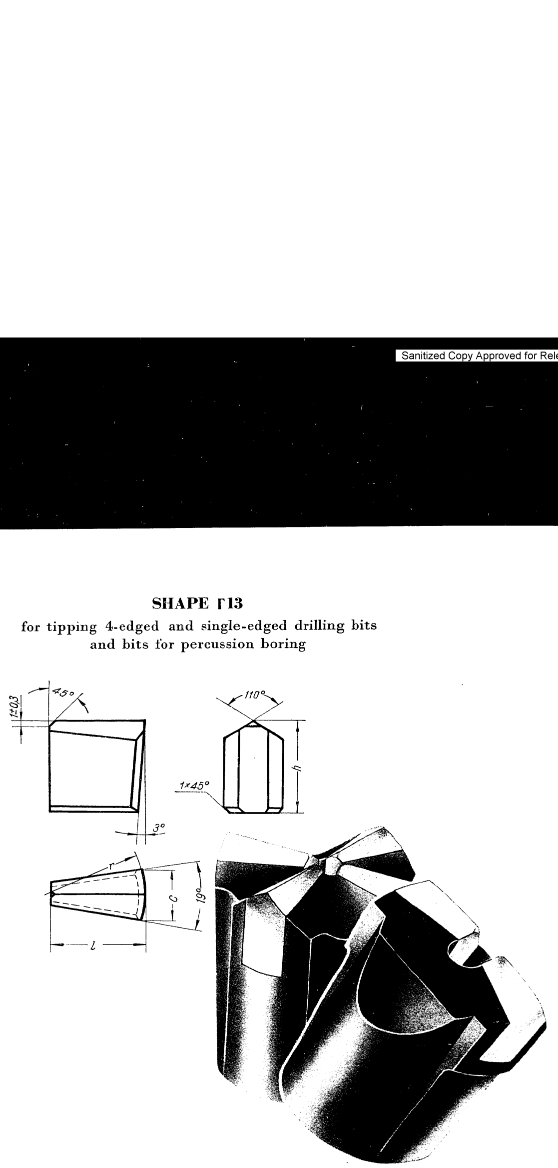


Tip No.	Dimensions in mm					Average weight of carbide tip of grades (in g)	
	l	h	c	r	a	BK 11	BK 15
Г 121	17	18	8	20	1	29.9	29.4
Г 122	18	18	10	21	1.5	38.5	38.0
Г 123	20	18	8	23	1	34.3	33.8
Г 124	20	18	10	23	2	42.7	42.1
Г 125	21.5	18	10	24.5	2	46.3	45.6
Г 126	24	18	10	27	2	52.4	51.6
Г 127	26	18	10	29	2	56.7	55.9
Г 128	28	18	10	31	2	62.1	61.2

2

SHAPE Γ13

for tipping 4-edged and single-edged drilling bits and bits for percussion boring

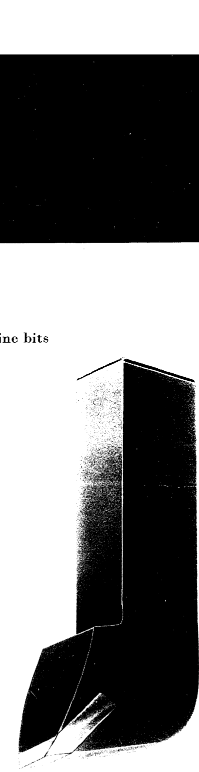


Tip No.	Dimensions in mm				Average weight of carbide tip of grades (in g)	
	l	*h*	*c*	*r*	BK 11	BK 15
Γ 131	17	18	10	20	27.5	27.2
Γ 132	17	18	12	20	34.7	34.2
Γ 133	18	18	10	21	27.8	27.4
Γ 134	18	18	12	21	35.3	34.8
Γ 135	20	18	10.7	23	32.5	32.0
Γ 136	20	18	12.7	23	40.5	39.8
Γ 137	21.5	18	13.2	24.5	45.2	43.6

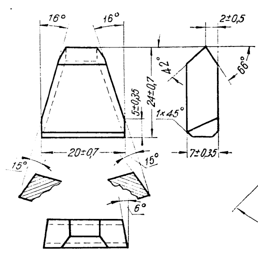
SHAPES Γ 21, Γ 22 and Γ 23

for tipping cutter picks and coal combine bits

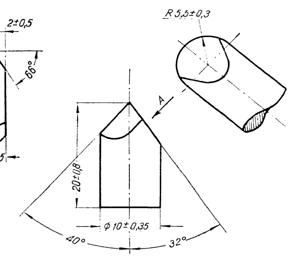
Shape Γ 21



Shape Γ 22



Shape Γ 23

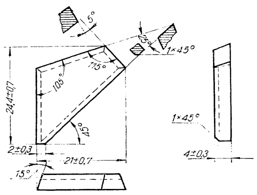


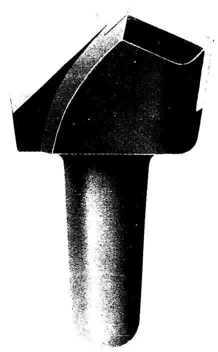
Average weight of carbide tip of grade BK 8
shape Γ 21 .... 12.3 g
shape Γ 22 .... 32.1 g
shape Γ 23 .... 17.5 g

SHAPES Г 31 and Г 32

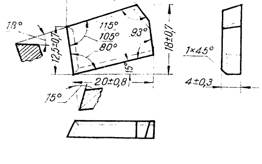
for tipping percussion boring bits, electric and pneumatic drills used in medium hardness formations

Shape Г31





Shape Г32

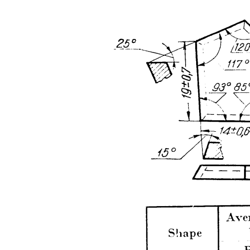


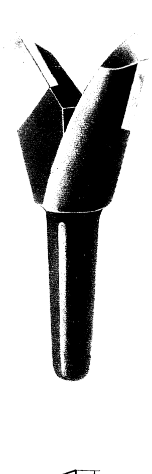
Average weight of carbide tip of grade BK8
shape Г 31 .... 14.9 g
shape Г 32 .... 13.0 g

SHAPES Г 33 and Г 34

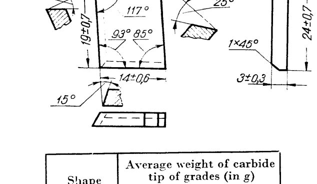
for tipping hand and percussion electric and pneumatic drills used in boring hard coals with great amount of hard inclusions and formations of medium hardness

Shape Г33





Shape Г34



Shape	Average weight of carbide tip of grades (in g)	
	BK6	BK8
Г 33	9.9	10.0
Г 34	12.9	13.2

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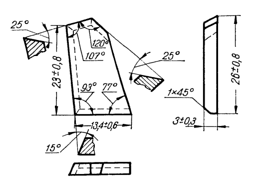
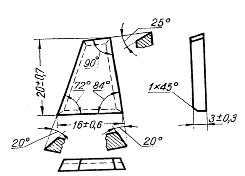
SHAPE Г 35

for tipping hand and percussion electric and pneumatic drills used in boring coals of different hardness with small amount of hard inclusions



SHAPE Г 36

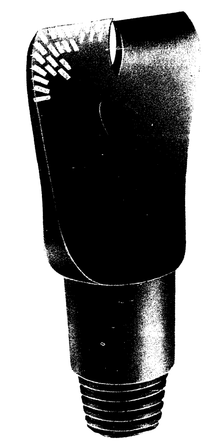
for tipping hand electric and pneumatic drills used in boring coals of soft and medium hardness free of hard inclusions



Shape	Average weight of carbide tip of grades (in g)	
	BK6	BK8
Г 35	11.9	12.2
Г 36	9.9	10.0

SHAPE Г 41

for tipping core bits and rotary boring chisels



Tip No.	Dimensions in mm			Average weight of carbide tip of grade BK8 (in g)
	a	b	c	
Г 411	3	15	1.5	1.0
Г 412	3	18	1.5	1.1
Г 413	6	20	4	6.9
Г 414	8	20	6	13.8

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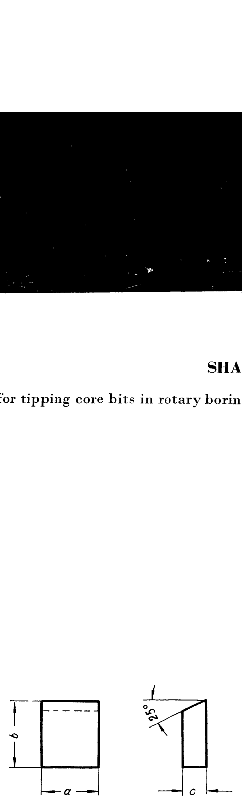
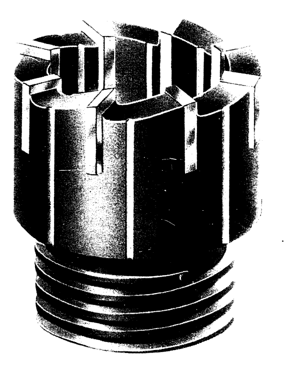
SHAPE Γ51

for tipping core bits in rotary boring of medium hardness rock formations

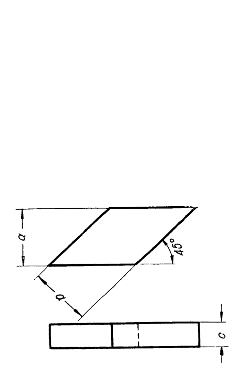


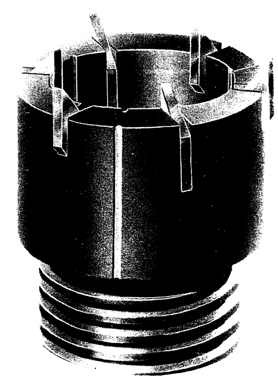


Tip No.	Dimensions in mm			Average weight of carbide tip of grade BK8 (in g)
	a	b	c	
Γ 511	5	7	3	1.4
Γ 512	7.5	10	3	3.0
Γ 513	8.5	8	3	2,8
Γ 514	8.5	10	3	3.4
Γ 515	10	14	4	7.6

SHAPE Γ52

for tipping core bits in rotary boring of soft rock formations

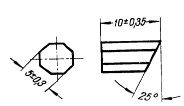


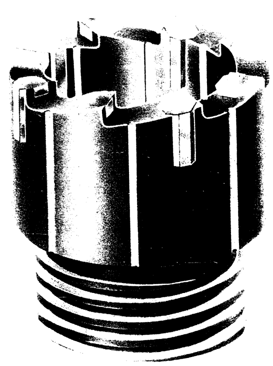


Tip No.	Dimensions in mm		Average weight of carbide tip of grade BK8 (in g)
	a	c	
Γ 521	8.5	3	4.4
Γ 522	12	4	12.9

SHAPE Γ 53

for tipping core bits in rotary boring of medium hardness rock formations

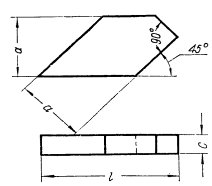


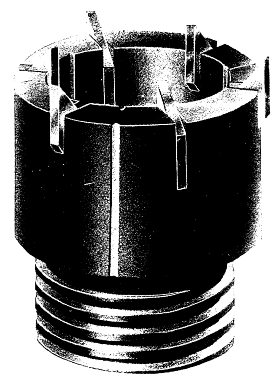


Average weight of carbide tip of grade BK 8 — 2.3 *g*

SHAPE Γ 54

for tipping core bits in rotary boring of soft rock formations





Tip No.	Dimensions in mm			Average weight of carbide tip of grade BK 8 (in *g*)
	a	*l*	*c*	
Γ 541	8.5	17.5	3	3.6
Γ 542	12	24	4	10.2

STANDARDS OF TUBE HARD-FACING ALLOY "RELIT T3"

Tube hard-facing alloy "Relit T3" is manufactured in rods of various diameters with various mesh sizes of tungsten carbide particles.

According to the mesh size of the particles the "Relit T3" alloy is graded as follows:

Grade	Mesh size of the cast carbide particles	Outside diameter of rod in mm	Colour of marking
T 32		7	green
T 33		6	yellow
T 34		5	white
T 35		4	blue

The rods are 400 mm in length.

Upon special request the tube hard-facing alloy can be made in any other mesh size.

OTHER GRADES OF HARD ALLOYS

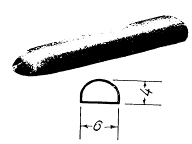
HARD ALLOY "RELIT Φ"

The "Relit Φ" represents in general a cast tungsten carbide made in the form of small pieces of various shapes.

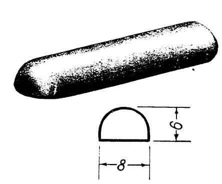
"Relit Φ" possesses great wear-resistance and is intended for tipping cutting type boring bits used for deep hole rotary drilling.

The hard alloy "Relit Φ" is made in the following shapes and dimensions:

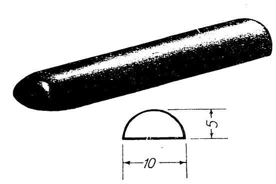
Shape No. 1



Shape No. 2



Shape No. 3



All the shapes are made in lengths of 15, 20, 25, 30 and 35 mm

HARD ALLOY "RELIT K"

The cast tungsten carbide representing the hard alloy "Relit K" has the same components as the granulated cast carbide filled into the tubes of the "Relit T 3" hard-facing alloy and is manufactured in small pieces of irregular shape having a cross section of 6—10 mm.

Similar to the "Relit Φ". "Relit K" is applied for tipping boring bits of cutting type used for deep rotary drilling.

The method of applying "Relit K" to the bits is the same as for "Relit Ф".

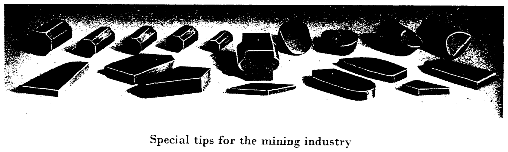
Particles of hard alloy "Relit K"

SPECIAL TIPS AND OTHER HARD ALLOY PRODUCTS

The continuously developing technique of rock drilling calls for the creation of new drilling methods and for new types of boring tools.

The new applied methods of boring pits and deep explosive and working pit-holes and other methods which can be anticipated in the nearest future, as well as new and more effective forms of working part of mining tools for already existing methods of boring, may require such hard alloy articles, which are not provided for in the above mentioned standards. Such products of any required form can be furnished by the Vsesojuznoje Exportno-Importnoje Objedinenije "Stankoimport" upon special orders.

When ordering special shapes of tips or other nonstandard products of hard alloys, drawings and technical data must be submitted.



Special tips for the mining industry

The numerous remarkable properties of the carbides offer great opportunities to engineers who are endeavouring to improve the design of machines, tools and devices and to increase their efficiency and stability.

III

INSTRUCTIONS

HOW TO MAKE HARD-ALLOY TIPPED PERCUSSIVE ROCK-DRILLS

At present time the most part of mining enterprises has begun to use percussive drili rods furnished with detachable core bits having a conical joint. Such core bits are being now produced at many machine building plants, and at large mining enterprises.

Operation with detachable hard alloy core bits brings considerable economy in hard alloys, reduces expenditure of boring steel more than two times, makes labour easier and more productive.

Along with detachable core bits are widely used percussive drill rods with hard alloy tipped heads.

The percussive drill rods are manufactured at mining enterprises for their own purposes.

Below are given some technical suggestions and short descriptions of the manufacturing and application of the hard-alloy tipped percussive drill rods.

PROCESS OF MANUFACTURING THE HARD ALLOY TIPPED PERCUSSIVE DRILL RODS

The percussive drill rod should be rectilinear. The bottom of the recess should be strictly perpendicular to the axis of the drill rod. The drill head should be in line whith the axis of the drill rod and should be placed symmetrically.

The process of manufacturing the hard-alloy tipped percussive drill rods consists of the following operations:

1. Preparation of steel material for rods.
2. Upsetting and hardening of the shank.
3. Upsetting of the head.
4. Cutting of the blow hole.
5. Preparation of the recess for the tip.
6. Tip grinding.
7. Fitting of the recess to the tip.

8. Fitting of head and tip for brazing.
9. Tip brazing.
10. Drill sharpening.

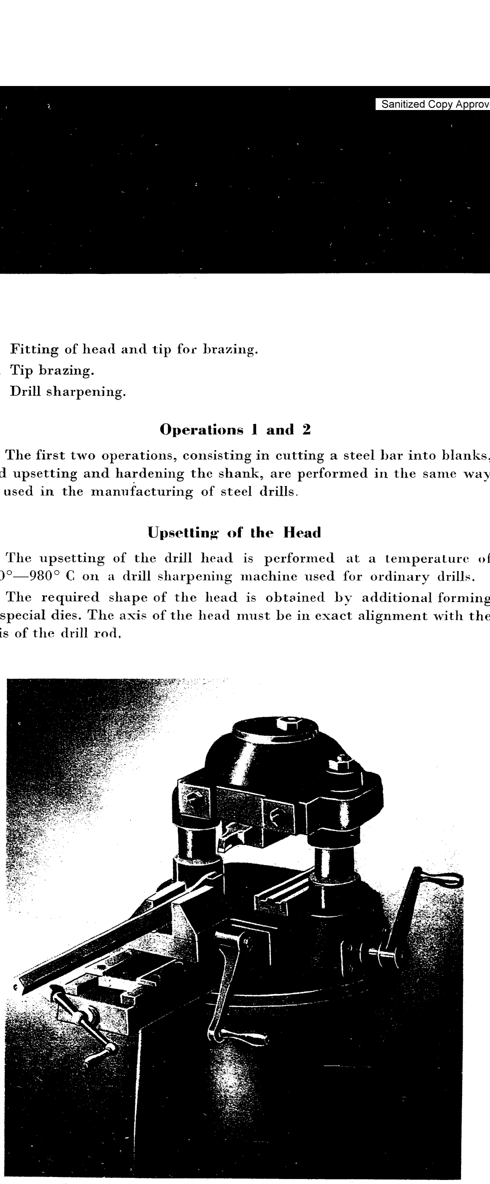
Operations 1 and 2

The first two operations, consisting in cutting a steel bar into blanks, and upsetting and hardening the shank, are performed in the same way as used in the manufacturing of steel drills.

Upsetting of the Head

The upsetting of the drill head is performed at a temperature of 950°—980° C on a drill sharpening machine used for ordinary drills.

The required shape of the head is obtained by additional forming in special dies. The axis of the head must be in exact alignment with the axis of the drill rod.



Fixture mounted on the drill sharpening machine and used for machining the recess

Cutting of the Blow Hole

The blow hole in the drill head is produced either on a drill sharpening machine by means of a special device consisting of a die and a punch or on a drilling machine by means of a jig. The direction of the hole should correspond as much as possible to the direction of the bore in the drill rod.

Preparation of the Recess for the Tip

When the cutting of the blow hole is completed the drill rod is preheated up to 900°—950° C and the recessing takes place. This operation is performed on a drill sharpening machine using a special device or by milling. The recess is made with an allowance of 0.1 to 0.2 mm for the subsequent machining.

Tip Grinding

The grinding (cleaning) of the tip contact surfaces which come into contact with the recess surfaces of the drill head is not absolutely necessary unless there appears some warping of the surface which prevents a close fit of the tip to the recess.

Tip grinding can be performed by a combined chemical and mechanical method based on destroying the cobalt binder of the carbide under the chemical action of copper vitriol solution and removing the destroyed layer by subsequent machining.

Tips, firmly held in special frames filled with sulphur, gypsum, etc., can also be ground on a surface grinding machine by means of green silicon carbide wheels.

Prior to brazing, tips should be cleaned by dipping in spirits or benzine.

Fitting of the Recess to the Tip

The fitting of the recess to the tip is achieved by a file. The clearance between the tip and the contact surface of the recess should not exceed 0.1—0.15 mm. Large and irregular clearance produce a thick and uneven layer of solder, and consequently reduce the strength of the brazed joint.

Preparations for Brazing

Prior to brazing the carbide tip is placed in the recess of the drill head and is fixed in a proper position by caulking.

In order to protect the carbide tip and the drill head against oxidizing during the preheating process, it is recommended to immerse the drill head with the fixed tip, prior to preheating, into a boiling solution of borax (1 kg of borax per 1 litre of water) where it should be kept for 3—5 minutes. The blow hole should be covered up with asbestos before brazing.

Tip Brazing

The brazing of the carbide tips to the drill head is the most important operation and should be performed with great care. The reliable soldering materials are brass of grades ПК, Л62 or ЛМЦ 58-2 in the form of strips of 1—2 mm thickness. Heated and finely crushed borax is used as a flux.

In order to avoid oxidizing of carbide tips, it is recommended to perform the heating of the drill head as well as the brazing with a non-oxidizing flame, for which purpose a slightly carburizing flame should be maintained in the flame furnace; when brazing is performed with an oxyacetylene torch, a non-oxidizing flame, with an excess of acetylene must be used. When torch brazing is applied, the flame should not be directed at the carbide tip. Only the drill head should be preheated.

Brazing is performed in the following way:

a) The drill head is sprinkled with borax and placed in the furnace where it is kept until the borax is melted; then the drill is removed from furnace, strips of solder cut to size laid on top of the drill head, and the whole sprinkled with borax, whereupon the drill is again placed into the furnace and heated to a temperature corresponding to the melting point of solder.

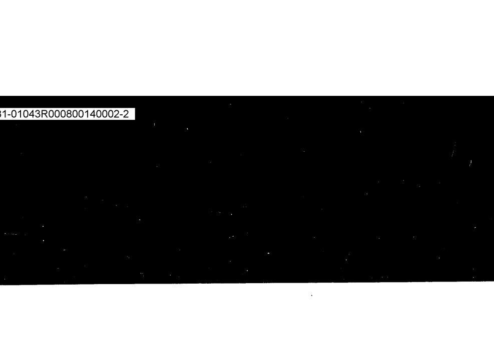
b) When the solder is melted, the drill is removed from the furnace, the tip quickly adjusted into a correct position (in case it has been moved in the recess) and then pressed to the bottom of the recess with the end of a steel bar.

c) The drill head is brushed clean from scale with a wire brush and is placed, for slow cooling, into a box filled with crushed charcoal or dry sloked lime, or some other material suitable for cooling.

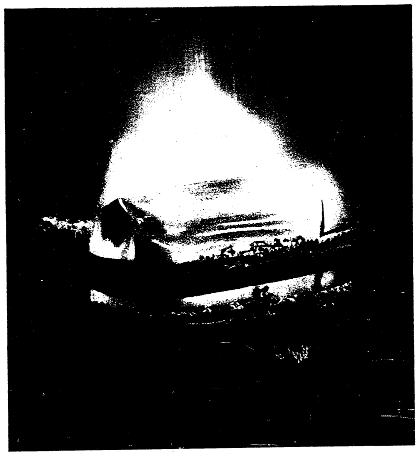
Brazing by Means of High-Frequency Currents

This method is the most efficient, convenient and economical one and ensures a high quality of brazing. Any equipment available for producing high-frequency currents may be used for this purpose. Heating of the drill and tip as well as melting of the solder are accomplished in an inductor, the shape of which should correspond to that of the drill head. Clearance between the inductor and the drill head should be within 4—6 mm.

The brazing process is identical to that applied for brazing in flame or electric furnaces.



Equipment for brazing drills by means of high-frequency current



Melting of solder in the high-frequency current inductor

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Drill and Core Bit Sharpening

The life of drill and core bits and the efficiency of drilling are vitally influenced by proper drill sharpening. For this reason sharpening should be performed with great care:

The process of sharpening is performed in two steps:

a) Rough grinding of drill head.

b) Carbide tip grinding.

Rough grinding of the drill head is performed on a tool grinding machine by means of an aluminium oxide wheel of 36—46 grain C_1—C_2 grade, with a surface speed of 25 m/sec.

Carbide tip grinding is performed with green silicon carbide wheels of 36—46 grain M_3—CM_1 grade, with a surface speed of 18—20 m/sec.

To obtain the proper quality of drill and core bit sharpening, the following basic rules are to be observed:

1. The grinding machine must be in good working condition. The spindle must be free from vibration.
2. Prior to use the grinding wheels must be balanced. During operation the wheels should be trued in due time.
3. During the grinding operation the wheel must rotate downwards to the cutting edge, i. e. it should "run" on to the carbide tip.
4. The grinding should be carried out either wet, with a continuous and ample supply of coolant, or dry, without any coolant at all. Under no circumstances should the coolant be supplied drop-wise or in the form of a spray, as it may cause cracks in the carbide tip. Wet grinding improves the quality of sharpening and reduces wheel consumption.
5. Tip grinding should be done by slightly pressing the tip against the wheel. Excessive pressure on the wheel will cause rapid wear of the wheel and may lead to tip cracking resulting from sharp local overheating.
6. Initial grinding, as well as regrinding of tipped core bits and drills should be performed by a skilled worker.
7. It is recommended to furnish the tips with the following angles:
   a) for drilling in rock formations of medium and ordinary hardness — 110°
   b) for drilling in rock formations of extreme hardness — 120°; the curve radius of the cutting edge should be equal to 180 mm.

   The correctness of sharpening should be checked with templates or with protractors.
8. When sharpening or resharpening the core bits and drills, a chamfer of 0.5 × 45° should be made on the ends of the cutting edge and the edge should be dulled with an abrasive brick up to 0.3—0.5 mm width.

While grinding the tip of the drill, it is necessary to take measures so that the edge would be strictly perpendicular to the axis of the drill. This insures symmetrical loading on the edge of the drill in boring.

APPLICATION OF ROCK DRILLS

The proper application of rock drills and detachable core bits tipped with sintered carbides is an essential condition for obtaining good results using hard alloys. In order to avoid rapid tool wear the following basic rules should be strictly observed:

1. The hard alloy grades are selected in accordance with the hardness and nature of the rock formation

When selecting a hard alloy grade for rock boring, the above mentioned recommendations should be adhered to. The main point in grade selection is: the higher the hardness of the formation to be drilled, the tougher should be the selected hard alloy. However, the toughness of the hard alloy should not be above that strictly necessary for drilling in a given rock formation as otherwise the hard alloy will loose in wear-resistance and this may cause a considerable loss in efficiency and an increase in hard alloy consumption.

2. The shape of the drill head depends on the capacity of the percussive drill and on the structure of the rock formation

The single-edged chisel drill head is more efficient than the four-edged one but at the same time it is exposed to higher stresses and is therefore less wear-resistant.

It is recommended to use the single-edged chisel drill head in all kinds of rock formations when drilling is done by percussive drills with a kinetic energy of impact not exceeding 6 kg. When drilling in extra hard rock formations with powerful percussive drills, it is more reliable to use hard-alloy tipped drills with four-edged drill heads. When drilling is performed in highly fissured rock it is recommended to use only the four-edged shape of core bits and drills, regardlees the rock hardness and the capacity of the percussive drill.

3. The primary drilling of blast holes to be carried out with special starting drills

The primary drilling of blast holes 2 or 3 cm deep should be done by a special starting drill with a four-edged bit; ordinary drills should be used at a later stage only. The diameter of the starting drill should exceed by 2—3 mm the diameter of the first one from a set of drills.

4. Gradual increase in air pressure

When starting boring, great care should be exercised; the percussive drill should be set into motion at a low speed, gradually increasing the air pressure and slowly moving the drill onwards. When the drill has penetrated into the formation to a certain degree, full air pressure may be supplied.

5. Proper selection of drill sets

For boring blast holes of 1.5 m deep and more a whole set of drills consisting of several pieces is required.

When choosing a set of drills and core bits, it should be borne in mind that the diameter of the bit next in size must be 1—2 mm less than that of the preceding drill bit, depending on the abrasive qualities of the rock formation. A minimum diameter drop should be aimed at in selecting the sizes of drills in the set as this will allow to reduce the primary diameter of the blast hole. A greater difference in the diameters of drills in the set is admissible only for drilling in highly abrasive rock formations which cause extensive wear of the drill bit. Each subsequent size of drill in the set should quite freely penetrate into the blast hole; otherwise the hard alloy tip may develop fractures.

In accordance with the above the sharpening of the drills making up one whole set should be carried out simultaneously, the correctness of the diameter drop of the drill bits being thoroughly checked.

When drilling by detachable core bits in non-abrasive rock formations, it is permissible to drill the blast hole with one core bit only without choosing a whole set, transferring the core bit from short rods to longer ones.

6. Cleaning of blast holes

When drilling is carried out dry, a blowing out is frequently required as the high speed of drilling developed by the hard-alloy tipped tools leads to rapid accumulation of dust in the blast hole. Belated and insufficient removal of dust inevitably leads to the reduction of efficiency of drilling.

7. Normal degree of wear

In order to avoid a loss in efficiency and an unreasonable consumption of hard alloys, the drills should be resharpened in due time and not be allowed to get excessively blunt. The dulling of the cutting edge as a result of wear should not exceed 1.5 mm in height. Another indication of wear is the width of the space formed at the corners of tips, the size of which should not exceed 3—3.5 mm.

8. Careful handling of tools

In order to avoid breakage of hard alloy tips and to exclude the possibility of cracks the hard alloy core bits should be handled with care and the drill bits should be protected against heavy impacts. It is not recommended to put the drill which has been heated during the drilling downwards on wet ground as this may cause cracks in the hard alloy tip.

HARD-FACING OF DRILL BITS FOR OIL WELL BORING

In order to increase their wear-resistanse and efficiency all the available kinds and shapes of drill bits of the cutting and crushing type are hard-faced with hard alloys.

The following conditions are indispensable to ensure effective performance of the hard-faced drill bits:

1. Tight brazing of the hard alloy to the body of the bit.
2. Sufficient shearing strength of the hard alloy.
3. Sufficient resistance of the hard alloys to abrasion exerted by the rock formations.

The above conditions are attained by proper selection of the hard alloy grades and by proper execution of hard-facing.

The hard-facing of drill bits is made either with one hard-facing alloy grade or with several hard alloy grades superimposed one upon the other on the surface of the drill bit.

The method of hard-facing drill bits with several hard alloy grades is now the prevailing one as it has many advantages in comparison with the first method.

When hard-facing is made with one grade of hard alloy, the powdered hard-facing alloy "Vocar" or the tube hard-facing alloy "Relit T3" is used for that purpose.

When the drill bits are hard-faced with several grades of hard alloys, the latter are used of various compositions, some of which will be described below.

The best results, with regard to wear-resistance and life of drill bits, are obtained in those instances when the hard-facing alloy is welded into grooves specially cut in the body of the bit.

HARD-FACING OF THE CUTTING TYPE DRILL BITS WITH "VOCAR" AND "BK 8" GRADES

This method consists in depositing the powdered hard-facing alloy "Vocar" and the sintered carbide "BK8" on the drill bits by means of welding.

The "Vocar" grade is used for hard-facing the working surfaces of the cutting edges, as well as the reaming edges and blades of the drill bits. On the cutting and reaming edges the hard-facing alloy is deposited in one or two layers and on the blades in two or three layers. The total thickness of the deposited layer of the "Vocar" grade should not exceed 2.5—3 mm, otherwise it becomes very brittle.

The hard-facing alloy "Vocar" should be deposited on a properly cleaned surface by a D. C. or A. C. electric arc using carbon or graphite electrodes. It is preferable however to use a D. C. electric arc, which has a direct polarity and possesses a greater stability and therefore gives better results. Inserts of the sintered carbides "BK8" are brazed on top of the deposited hard-facing alloy "Vocar", on the working surface of blades and along the reaming and cutting edges in accordance with the adopted diagram of insert spacing.

Cast iron rods 6 to 12 mm in diameter and 400—700 mm in length are used as solder.

Before brazing the sintered carbide inserts the surfaces covered with "Vocar" should be ground in odrer to remove scale and roughness.

HARD-FACING OF THE CUTTING TYPE DRILL BITS WITH HARD ALLOYS "VOCAR" AND "RELIT T 3"

Hard-facing of the drill bits is done with the powdered hard alloy "Vocar" and the tube hard-facing alloy "Relit T3".

These two alloys supplement each other and produce a perfect protection against the abrasive effect of the rock formation.

The depositing of the hard-facing alloy "Relit T3" on top of 2 or 3 layers of "Vocar" increases the toughness of the latter as the steel tube of "Relit T3" gets fused with "Vocar" during the process of welding. In their turn the hard tungsten carbide grains of "Relit T3", remaining intact in the tough steel "Vocar" medium, increase the resistance of the hard alloy layer to abrasion and consequently prolong the life of the drill bits.

The blade angles of the bit are covered with coarse-grained hard-facing alloy "Relit T3".

The hard-facing of drill bits by this method is performed in two steps:

a) Depositing of the "Vocar" bedding by an electric arc.

b) Depositing of the "Relit T3" tube hard-facing alloy by torch flame.

The hard-facing of the drill bits is preceded by cutting grooves of 10 mm width, 55, 70, 80 or 100 mm length and 4—5 mm depth with a carbon electrode on the working surface of the blades (other sizes of grooves may be chosen as well).

The number of grooves depends on the size of the drill bit as may be seen from the following table:

Diameter of drill bit in inches	5¾	7¾	8¾	9¾	10¾	11¾	12¼	13¾	14¾	15¾	16¾	17¾	18¾	19¾	21¾	23¾	25¾
Number of grooves on working blade of the drill bit	3	3	4	4	5	5	6	6	6	7	7	8	8	9	10	11	11

The grooves in the blades of the drill bit should be displaced with regard to one another so as to avoid their coincidence.

The grooves are filled up with one to three layers of "Vocar". The depositing is performed by a D. C. electric arc using carbon electrodes 8 mm in diameter at an amperage of 180—200 A. The total thickness of the deposited "Vocar" is 2.5 mm for two layers and 3.5—4 mm for three layers.

Upon the filling-up of the grooves the blade surfaces should be covered with one layer of "Vocar", starting from the cutting angle and then moving further, between the grooves. The last to be covered is the reaming edge of the drill bit which receives one layer of "Vocar".

The hard-facing with "Relit T3" tube hard alloy is made by means of an oxyacetylene torch with a No. 5 tip.

The reaming edges of the bit are the first to be covered and the deposited layer should increase in thickness from the centre outwards to the side of the bit blades.

Then the reaming edge is hard-faced up to the nominal diameter size. The reaming and cutting edges as well as the blade surfaces are deposited with tube hard alloy "Relit T3" of 4—10 or 10—20 mesh size.

In order to protect the large sized grains from chipping off a layer of "Relit T 3" of 30—40 or 40—60 mesh size is superimposed on the deposited layer.

After hard-facing the bits are subjected to normalization which consists in slowly heating the bits in furnaces up to 850°—870° C and keeping them at that temperature during one hour.

Then, the bits are cooled down to a temperature of 600°—620° C, removed from furnace and placed into a sand bath for complete cooling.

To obtain good results in hard-facing the following rules should be strictly observed:

1. Prior to depositing "Vocar" by an electric arc or "Relit T3" by a torch, the bit should be properly cleaned.
2. The bit should be so set for hard-facing that the surfaces to be hard-faced are placed horizontally.
3. When hard-facing with "Relit T3" is performed by means of an oxyacetylene flame, a torch with a non-oxidizing flame i. e. with an excess of acetylene should be used in order to protect the bit surface and the deposited alloy from oxidizing.

   When the flame is properly adjusted, its non-oxidizing zone (flame cone) is approximately three times longer than the inner flame core, which has no distinct outline.
4. In the course of hard-facing the rod of "Relit T3" should be kept at an angle of 15—20° to the surface being hard-faced and the torch tip at an angle not less than 45°. The flame core should be kept away from the surface of the bit at a distance of 3—4 mm.

HARD-FACING OF THE CUTTING TYPE DRILL BITS WITH HARD ALLOYS "RELIT Ф" AND "RELIT T3"

Hard-facing of these bits is made with cast tungsten carbide hard alloy "Relit Ф" and with tubular hard-facing rods of "Relit T 3". The spacing of "Relit Ф" inserts may be effected according to various schemes, some of which are shown below.

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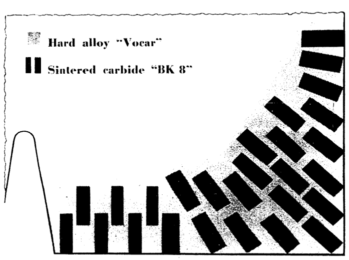
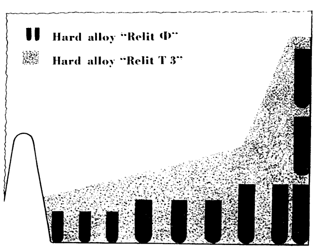
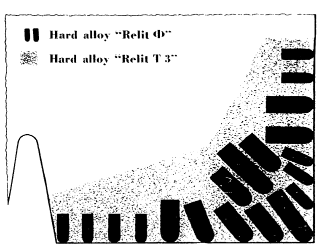
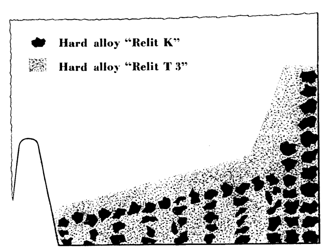
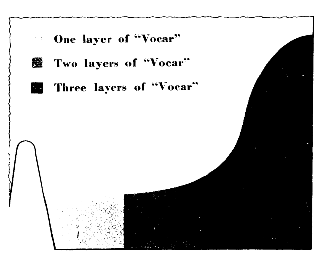
Schemes of Tipping „Fish-tail“ Bits with Hard Alloys for the Oil Industry

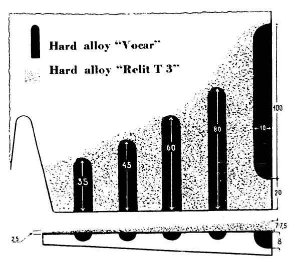












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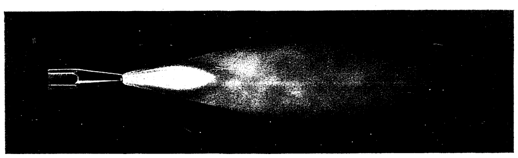
Welding of the "Relit Ф" inserts is performed by an ordinary oxyacetylene torch No. 5. The torch flame must be non-oxidizing i. e. it must have some excess of acetylene.



Non-oxidizing oxyacetylene torch flame

The "Relit Ф" inserts are first welded to the reaming edges and then further on in the direction of the centre. The flame core should be brought to the surface of the bit at a distance of 3—4 mm. The angle of the torch tip should not exceed 45°.

The drill bit is placed on a special table or in a special device. The operator avails himself of a torch and a steel welding rod (Steel "ЭЛ - 1" is recommended) 8—10 mm in diameter — and 300—400 mm in length, which is fixed in a holder. A groove is made by the torch flame in the body of the bit. Then the operator brings the steel rod close to the torch, heats it to the melting point and quickly seizes with the heated rod a "Relit Ф" insert. The insert is then placed in the flame and kept there until it gets white-hot. Thereupon the operator puts the insert into the molten metal in the prepared groove, moves the torch flame to the jointing point of the insert with the rod, cuts off the rod and uses it to weld the edges of the insert.

This operation is then repeated over and over in the same way.

When the "Relit Ф" inserts are welded on top of one blade of the bit by means of an oxyacetylene torch flame the blade is covered with two layers of tube hard-facing alloy "Relit T3" having a mesh size of 10—20, 20—30 or 30—40. Thereupon the bit is turned on its rib and the latter is also covered with two layers of hard alloy "Relit T3".

In case the hard-facing of the drill bits is made with cast tungsten carbide hard alloy "Relit K" the above method remains unchanged.

HARD-FACING OF THE CRUSHING TYPE DRILL BITS

In order to increase their wear-resistance the crushing type drill bits (reed roller rock bits) are hard-faced with tube hard-facing alloy "Relit T3". Hard-facing is applied to the teeth and the outside face of the reed roller bits.

During machining special undercuts or grooves are made on the end faces of the teeth for depositing the hard-facing alloy.

The hard-facing of the inner surfaces of the roller bit teeth should be made on the running-down side of the tooth (in the direction of rotation) along two-thirds of its height and across the whole surface. This ensures selfsharpening of the teeth when the bits are used for drilling in hard rock formations. Besides that the outer teeth (first crown) of the roller bit are also hard-faced on the running-on inner surface along two-thirds of the tooth height and across one-third of its length. The hard-facing with "Relit T3" is performed by means of an oxyacetylene torch with tip No. 3 or 6 depending on the size of the roller bit.

The torch flame should be neutral, this being obtained by so adjusting the tips that the flame shows an excess of acetylene. When the flame is properly adjusted, its non-oxidizing zone (cone) must be about three times as long as the inner flame core, the latter having no distinct outline.

The mesh size of hard alloy "Relit T3" is selected in accordance with the size of the roller bit. Correspondingly the end faces of the external teeth and the reaming edges are hard-faced with hard alloy having a mesh size of 20—30 or 30—40 and the inner surfaces of the teeth with an alloy of 30—40, 40—60 or 60—80 mesh size.

Hard-facing of the roller rock bits should begin with the end faces of the teeth and then be continued on their inner surfaces.

Prior to welding the parent metal of the roller bit should be preheated by a torch until an extremely thin film of molten metal appears on the heated surface. Then a tube of hard alloy "Relit T3" is placed in the neutral zone of the torch flame to be thoroughly preheated prior to depositing which is necessary in order to ensure firmness of bond between the tungsten carbide grains of "Relit T3" and the parent metal of the roller bit.

During the process of hard-facing it is necessary to watch that the teeth are not overheated and their edges not fused, also that the deposited layer of the hard alloy is not too thick, as this may lead to excessive consumption of the hard alloy and an increase in brittleness and may alter the required shape of the tooth.

The thickness of the deposited hard alloy layer varies from 1 mm on the top of the teeth up to 5 mm on their face.

During the process of hard-facing the flame core should be kept at a distance of 3—4 mm from the deposited layer.

When hard-facing with "Relit T3", care should be taken to avoid roughness, slag inclusions and overburnings.

If some roughness appears it is necessary to heat the surface by means of a torch and then to make it even.

When the hard-facing of all the roller bit teeth has been finished and they have been checked with templates, the bits are cleaned from scale and are placed into a sand bath for complete cooling. After hard-facing, the roller bits are heat treated.

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HARD ALLOY TIPPING OF CORE BITS USED FOR PROSPECTING BORING

All kinds of core bits applied for prospecting purposes are tipped with hard alloy.

The technological process of tipping the core bits with tungsten carbide inserts of the Г 53 shape (octagonal shape) consists in the following.

PREPARATION OF THE CORE BIT RING

The blanks of the core bit rings, intended for tipping with tungsten carbide inserts, are made with an allowance of 2 mm on side for the subsequent machining.

The centres of holes for the carbide inserts are marked with a centre punch on the face of the ring using a template specially made for that purpose.

The centres of the hard alloy inserts are arranged in chessboard order one on the inside and the other on the outside of the face of the core bit. The drilling of the holes for the tungsten carbide inserts is performed at a right angle to the end face of the core bit using a drill of a diameter equal to the diameter of a circumference inscribed into the octagonally shaped insert. The above mentioned 2 mm allowance on side of the core bit is required to prevent the drill from deviation and to keep it working in the solid body of the bit. When large quantities of core bits of the same type are produced drilling is performed by means of a jig.

In order to secure a firm position of the carbide inserts, the round holes in the core bit are shaped into octagons by means of a special arbor. For that purpose, a steel arbor, having the same shape and size as the carbide inserts but with a taper at the end to facilitate extraction from the hole, is driven into the hole by slightly hitting it with a hammer.

Then the body of the core bit is machined both on the inside and outside diameters to final size, owing to which the lateral edges of the inserted octagonal tips protrude both inward and outward of the core bit body by 0.5—0.7 mm, thus preventing sticking of the core bit in the oil well during the drilling operation.

BRAZING OF SINTERED CARBIDE TIPS

The brazing of the sintered carbide tips into core bits is performed either in electric, gas or oil furnaces or by high-frequency current or when other heat sources are not available — by means of an oxyacetylene torch. Prior to brazing both the holes in the core bit and the carbide tips

should be cleaned and dehydrated in a benzine bath. Then the carbide tips are pressed into the holes of the core bit with a parallel vice or by imparting slight impacts with a copper hammer. In order to avoid chipping-off of the hard alloy tip, the vice jaws are covered up with copper or aluminium strips.

Brass of grades ПК, Л62 or ЛМЦ58-2 in the shape of small pieces of wire or strips 1—2 mm thick is used as soldering material. As a flux material it is recommended to use fine crushed and annealed borax.

To avoid oxidizing of the hard alloy inserts the heating of the core bit and brazing should be carried out in a non-oxidizing atmosphere, for which purpose a slightly carburizing flame should be maintained in the oil furnace or when the brazing of the inserts is performed by means of an oxyacetylene torch, the flame of the torch should have an excess of acetylene.

When a torch is applied for brazing, the body of the core bit should be preheated; then each area for brazing should be successively heated up to the melting point of the solder, without directing the torch flame at the sintered carbide insert.

The cooling of the core bit, after the carbide inserts have been brazed, should be carried out slowly and uniformly in a box filled with pulverized charcoal or with dry hydrated lime.

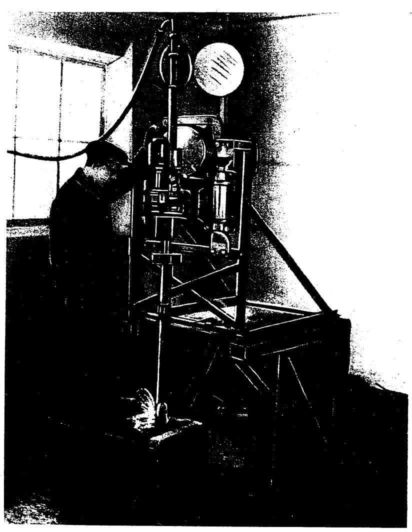
SHARPENING OF CORE BITS AND FINAL OPERATIONS

The sharpening of the sintered carbide inserts is performed by means of green silicon carbide wheels of 60—80 grit with 20 m/sec surface speed.

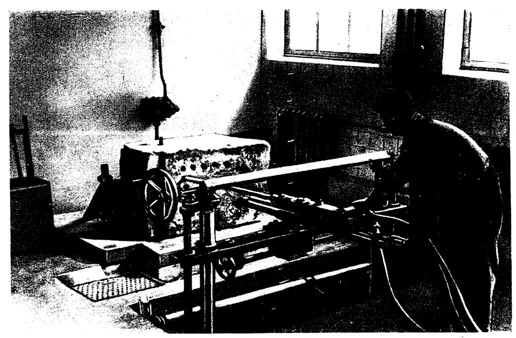
For drilling in hard and fissured rock formations the inserts should be ground at an angle of 65—75° and up to 85°, for drilling in soft formations the angle should be decreased to 50—55°.

The grinding should be effected by slightly pressing the inserts against the grinding wheel. Then some steel of the core bit body is removed with a file or with a grinding wheel at the same angle at which the inserts were ground, so that the cutting edge of each next insert protrudes by 2—3 mm over the body of the core bit. To secure a uniform wear of the carbide insert it is necessary to grind off slantwise the inner edges of the outer inserts and the outer edges of the inner inserts in the centre of the core bit face and along its side. After sharpening has been completed a groove for cooling purposes is made in front of each insert and then the threads are cut. In case these operations are carried out prior to brazing of the hard alloy inserts, the threading should be covered up with asbestos to protect it during the process of heating and other operations.

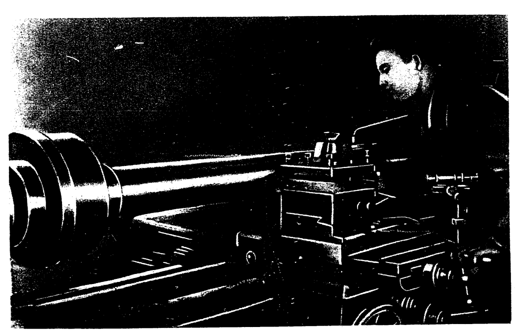
Each lot of hard alloy tips undergoes a thorough examination and is subjected to diverse tests



Testing of hard alloy tips for prospecting boring core bits on a special stand



Testing of hard alloy tips for percussion boring on a special stand



Testing of the cutting properties of hard alloy tips for metal cutting

IV

CARBIDE PRODUCTS USED IN OTHER BRANCHES OF INDUSTRY

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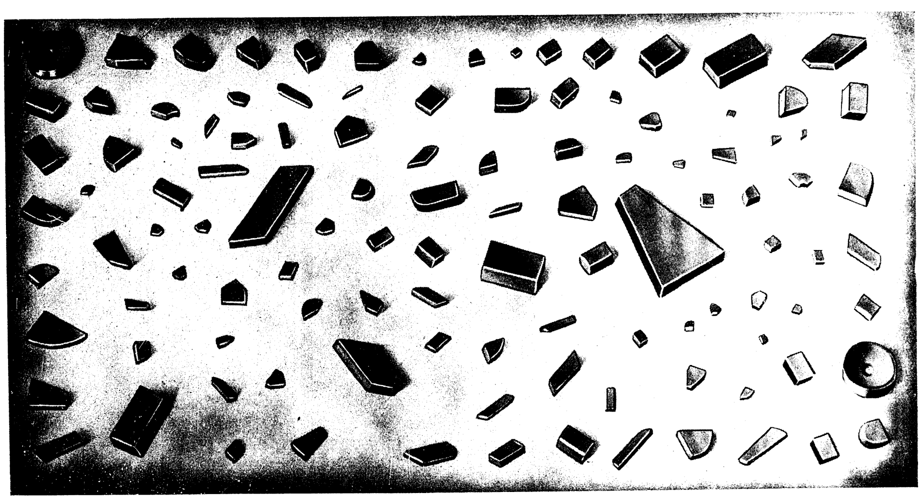
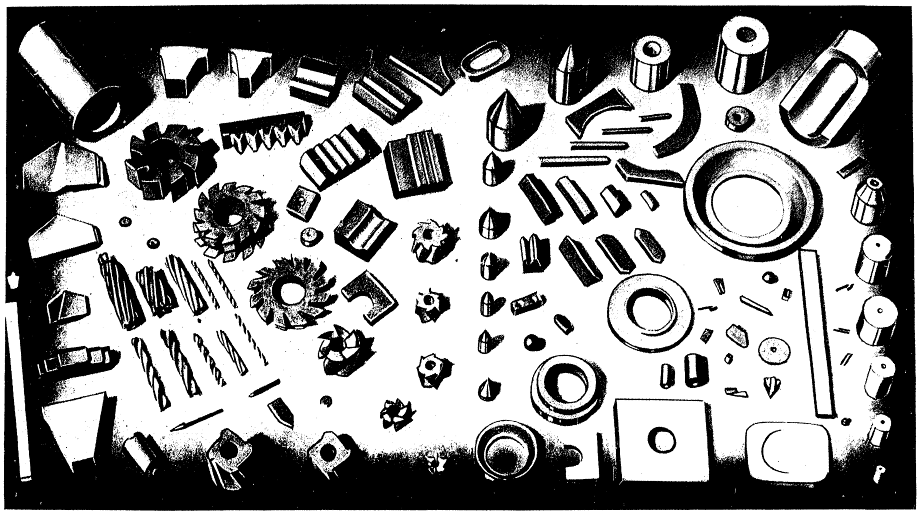
Standard carbide tips used for metal cutting are produced in accordance with GOST 2209-49

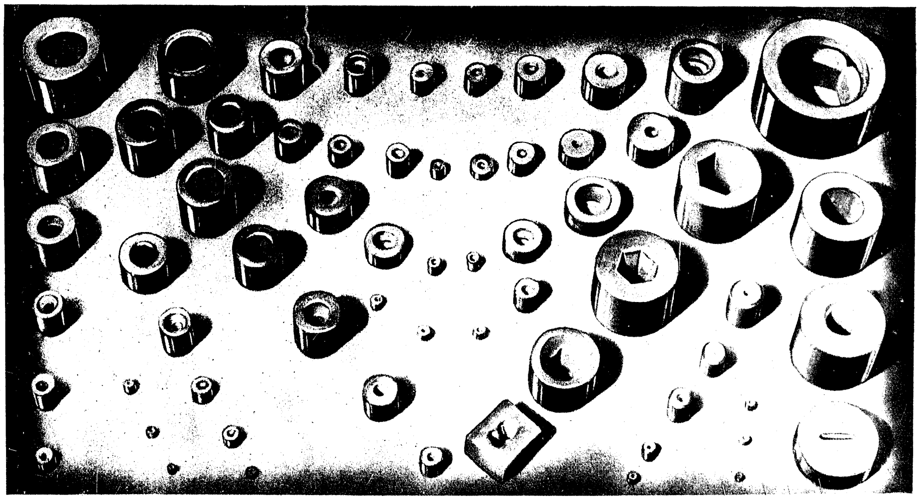


These products and their application are dealt with in our catalogue No. 8 as well as in a new catalogue No. 12 being prepared for issue.

Various carbide products used for tipping special small tools, as well as various machine parts are produced in accordance with drawings submitted by the customer



Standard and shaped blanks for drawing dies are produced in compliance with GOST 2330-49, 3919-47 and 5426-50, as well as according to customer drawings



These products and their application are dealt with in our catalogue No. 10.

All inquiries and correspondence to be forwarded to:
Vsesojuznoje Exportno-Importnoje Objedinenije
"STANKOIMPORT"
32/34 Smolenskaja-Sennaja pl., Moscow, U. S. S. R.
For cables: Stankoimport Moscow.
Phone: G 4-21-32.

Design and specifications of the hard-alloy products illustrated herein are subject to change without notice.

Vneshtorgizdat. Order No. 2435

CABLE ADDRESS:
STANKOIMPORT
MOSCOW